NASA TECH BRIEF

Lewis Research Center

Thermocouple Tape

A preformed, low cost, thin film thermocouple in the form of an adhesive tape has been conceived and a prototype fabricated. The sketch depicts such a disposable thin film thermocouple tape with preformed junctions. As shown in Figures 1 and 3, a thin layer of metal "A" is deposited along one edge of a plastic tape, and a thin layer of a dissimilar metal "B" is deposited along the other edge of the tape and overlaps layer "A" to form a thermocouple junction area along the center portion of the tape. Figure 2 illustrates a thermocouple formed from a length of tape by severing the layer of metal "B" at the middle of the tape length and removing a strip of the center overlap to form an aperture. This establishes a measuring junction at one end of the tape length and a reference junction at the other end. The low mass of the thin film thermocouple junction area contributes a fast response time. The two portions of the severed metal "B" layer may serve as connecting leads to the measuring apparatus. Figure 3 illustrates the adhesive layer applied to the bottom of the tape and a protective (optional) cover applied to the top.

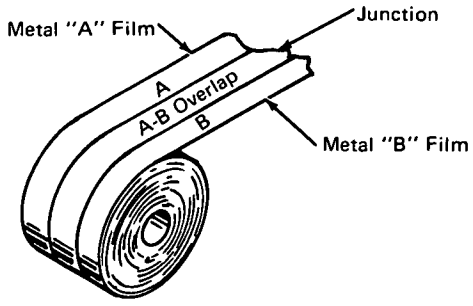

Figure 1. Roll of Thermocouple Tape

The self-adhering thermocouple tape can be manufactured in a variety of materials, sizes, and configurations. For example, the thermocouple adhesive tape could be made in roll form and dispensed in the same manner as commercial plastic tapes. By dispensing the appropriate length of thermocouple tape, pressing it to the surface to be monitored (including lead-in areas if desirable), and tearing away the appropriate length of preformed junction area; a complete custom fitted thermocouple could be installed and attached to a measuring instrument without the aid of soldering or welding equipment or other additional attaching materials. The junction areas could be made as large or as small as desirable; the only tools needed would be a knife or a pair of scissors.

The cost of the thin film thermocouple tape should be low, compared to commercial wire thermocouple materials, due to the low mass of metal required for

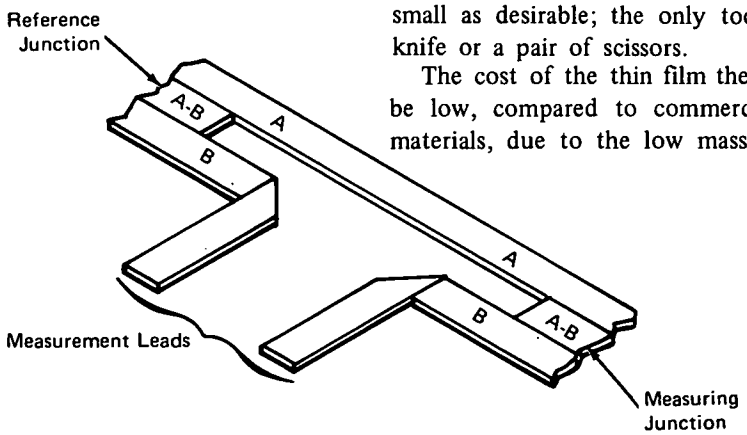

Figure 2. Complete Preformed Thermocouple

(continued overleaf)

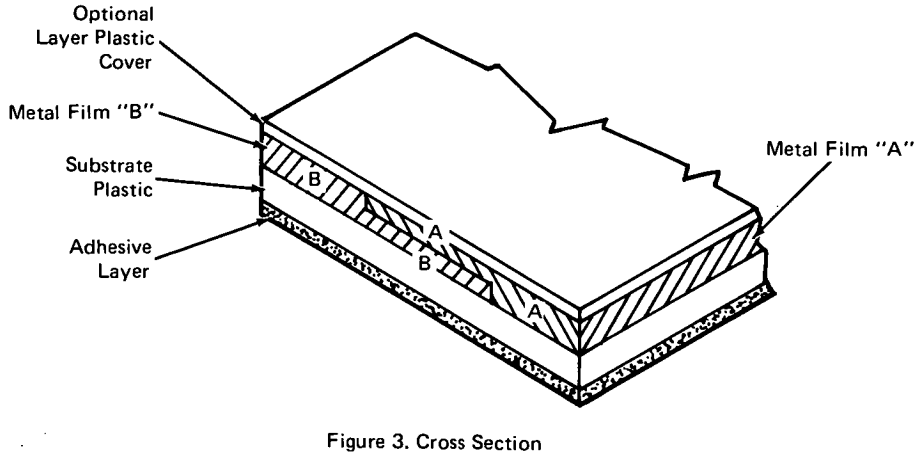

Figure 3. Cross Section

the thin films, particularly in the case of noble metal thermocouples. The design of the thermocouple tape is readily adaptable to automated production.

A prototype thin film copper-constantan thermocouple tape was successfully fabricated using sputtering techniques for applying the metal films. Films of copper and constantan nominally 6000 angstroms thick were deposited on an 0.051-mm (0.002-inch) thick polyimide plastic film. The useful temperature range for the polyimide film selected (estimated to be the minimal useful range for the tape thermocouple) was 4 K to 673 K. Initial evaluation of this tape thermocouple showed good agreement with a standard wire thermocouple at 298 K with an ice bath reference temperature.

Thermocouple	EMF (Ice Bath Ref)	T(K)
Thin film tape (copper-constantan)	+0.87 mV	296
Commercial wire (copper constantan)	+0.96 mV	298

(The −2 K discrepancy observed for the tape thermocouple is believed to be attributable to the short conduction path length (16.5 cm or 6.5 in) between the reference and measuring junctions of the prototype.

Notes:

1. The novelty of this invention is that it provides a thermocouple in the form of a tape which may be easily and quickly sized, formed, and applied.
2. The thermocouple tape application could be extended to higher temperatures by proper selection of substrate, adhesive, and protective cover materials.
3. The following documentation may be obtained from:
   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)

   Reference: N71-31123, Thermocouple Tape Patent Application (SN 104,885)
4. Technical questions may be directed to:
   Technology Utilization Officer.
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B72-10515

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

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